(54) Title: ADDRESS TRANSITION AND MESSAGE CORRELATION BETWEEN NETWORK NODES
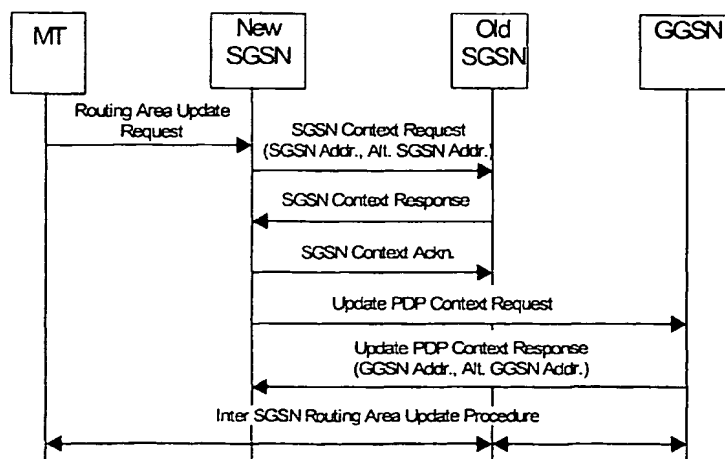
(57) Abstract: The present invention relates to a method, system and network element for providing an address transition if a connection point at one end of a connection is changed from a first network node to a second network node of a cellular network. An address information and at least one alternative address information are transmitted in a signaling message from said first network node to said second network node. One of said address information and said alternative address information is selected at the second network node and used for re-establishing said connection towards the other end of said connection. Thereby, the new point of connection is allowed to re-establish the connection towards the other end of the connection, even if it can only communicate using one of the two addresses. Furthermore, signaling messages, e.g. messages relating to charging, lawful interception, and/or customized applications, received from different network nodes can be correlated based on the alternative addresses.

- 1 -

Address Transition and Message Correlation Between Network Nodes

FIELD OF THE INVENTION

The present invention relates to a method, system and network element for provid-
ing an address transition, such as a transition from an IPv4 (Internet Protocol ver-
5   sion 4) address to an IPv6 address, between a first network node and a second
network node of a cellular network, e.g. a GPRS (General Packet Radio Services)
network, and/or a message correlation.

BACKGROUND OF THE INVENTION

UMTS (Universal Mobile Telecommunications System) is a more general term for
10   the 3G (third generation) telecommunications system based on the WCDMA high
capacity radio interface. GSM is the most widespread 2G (second generation)
telecommunications system based on TDMA (Time Division Multiple Access) ra-
dio. The goal of the GPRS system is to provide global layer 2 connectivity from a
cellular mobile terminal (MT, sometimes also referred to as mobile station (MS) or
15   user equipment (UE)) using 2G or 3G radio technology (e.g. GSM, American
TDMA, UMTS, GERAN (GSM/EDGE Radio Access Network) to an external packet
data network. GPRS can support various layer 3 protocols (e.g. IPv4; IPv6; PPP
(Point-to-Point Protocol)).

20   The main nodes of a GPRS network are SGSN (Serving GPRS Support Node)
and GGSN (Gateway GPRS Support Node). SGSNs are the nodes serving the
MT. Each SGSN supports GPRS for GSM and/or UMTS. GGSNs are the node
handling the interworking with PDNs (Packet Data Networks). Signaling and data
are exchanged between SGSN and GGSN or SGSN and SGSN using the GTP
25   (GPRS Tunneling Protocol) protocol. GTP protocol handles mobility, and creation,
modification and deletion of GTP tunnels, as well as transfer of user data between
GSNs. GTP allows multi-protocol packets to be tunneled between GSNs and be-
tween an SGSN and the UMTS Terrestrial Radio Access Network (UTRAN, not
shown) through which a connection to the concerned MT is established. Other
30   systems components need not be aware of the GTP. Typically, two IP addresses

are used for a single tunnel, one for the GTP control message (i.e. signaling) and one for the GTP user packet (i.e. carrying user data).

At GPRS attach, the SGSN establishes a mobility management (MM) context

5   containing information pertaining to e.g. mobility and security for the concerned MT. At PDP context activation, the SGSN establishes a PDP context, to be used for routing purposes, with the GGSN the subscriber will be using.A GPRS attached mobile terminal (MT) can be assigned either a static or dynamic IP address (referred to also as PDP address). The static address is assigned by the Home Pub-

10   lic Land Mobile Network (HPLMN) operator at the time of subscription. The dynamic IP address can be allocated by a GGSN (Gateway GPRS Support Node) of either the HPLMN or the visited PLMN (VPLMN) operator at PDP (Packet Date Protocol) context activation time. In addition to address allocation, the GGSN implements the forwarding of IP packets from a GTP (GPRS Tunneling Protocol)

15   tunnel to a packet data network (PDN) and vice versa. There are two kinds of PLMN backbone networks, an Intra-PLMN backbone network and an Inter-PLMN backbone network. The Intra-PLMN backbone network is a private IP network intended for packet domain data and signalling within a PLMN only, while the Inter-PLMN backbone is used for roaming from one PLMN to another (via Border Gate-

20   ways). Serving GPRS Support Nodes (SGSNs) and GGSNs use the Intra-PLMN backbone to exchange GPRS domain data and signalling.

During roaming, both the Intra-PLMN backbone of the home and visited networks are used in addition to the Inter-PLMN backbone. When a subscriber is roaming to

25   another PLMN, i.e. a VPLMN, the user needs to first attach to the network. In GPRS attach, the MT informs the Serving SGSN of its intention to connect to the network by giving information about its identity, capability and location. The SGSN then checks the MT's identity and performs an authentication procedure in order to secure the transmission path. The attachment is completed after the SGSN has

30   received roaming subscriber data from the Home Location Register (HLR) of the subscriber's HPLMN and finished a location update procedure. After the GPRS attach, the MT sends an 'Activate PDP context' request, in which the Access Point Name (APN) is a reference to the GGSN Access Point (AP) to be used in either

the home or visited PLMN. The SGSN selects the GGSN based on a PDP context subscription record and sends the context data to a selected GGSN. The GGSN then routes the packets to the appropriate Packet Data Networks (PDN).

5   When a subscriber is roaming in the VPLMN, there are the following two possibilities for GGSN selection. Firstly, the home network GGSN can be used via the Inter-PLMN backbone and BGs. The home GGSN then routes the packets to their destination. Secondly, a visited domain GGSN can be used for routing the packets from the VPLMN to their destination directly through a packet data network (PDN),
10   such as the public Internet.

It should be noted that there are two levels of IP addressing:

-    the user IP address corresponding to the packets carried over GTP proto-
15   col. The corresponding IP address is referred to as PDP address or user
          address; and

-    the network IP address corresponding to the packets carried below GTP
          protocol. The corresponding IP addresses are the node IP addresses used
20   to exchange GTP packets between GSNs. These IP addresses might also
          be used for network operation such as charging or O&M.

User and network addresses are independent of each other thanks to the GTP protocol, and could both be either IPv4 or IPv6.

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The GPRS backbone nodes of the second (2G) and third (3G) generation may optionally use an IPv6 based addressing for network addresses. However, existing specifications allowing the use of IPv6 addresses, do not define how to maintain backward compatibility with IPv4 based nodes. An SGSN should know in advance
30   that the GGSN selected supports IPv6 addresses before inserting an IPv6 address e.g. in a create PDP context request message.

Furthermore, another problem arises with the known procedures. If a MT moves from an IPv6 capable SGSN connected to an IPv6 capable GGSN to an IPv4 only
35   SGSN, the communication will get lost as the new SGSN cannot use the IPv6 ad-

dress transferred. Such a scenario is very realistic in particular when two operators with equipment from different manufacturers (or just different software release) have roaming agreements (e.g. national roaming). It should be noted that existing IPv4-to-IPv6 transition mechanisms do not apply here as they do not affect IP ad-
5   dresses carried in GTP.

In addition, a practical requirement is that the protocol changes have to be done so that nodes based on older version of specifications (and so not supporting enhancement proposed here), have to continue interworking with new nodes sup-
10   porting the proposed enhancement proposed here.

SUMMARY OF THE INVENTION

It is therefore an object of the present invention to provide a method and system for providing an address transition or correlation function, by means of which
15   backward address compatibility can be achieved.

This object is achieved by a method and system as claimed in claims 1, 13, 17 and 19, respectively.

Additionally, the above object is achieved by a network node as claimed in claims 23, 27 and 30, respectively.

20   Accordingly, if one of the point of connection is changed (e.g. Inter SGSN Routing area update; Serving RNC relocation), the old point of connection (e.g. old SGSN) shall send to the new point of connection (e.g. new SGSN) both first and second address, in order to allow the new point of connection to re-establish the connection towards the other end of the connection (GGSN), even if it can only communi-
25   cate using one of the 2 addresses.

Furthermore, signaling messages, e.g. messages relating to charging, lawful interception, and/or customized applications (e.g. Customized Applications for Mobile network Enhanced Logik (CAMEL) architecture), received from different network nodes can be correlated based on the alternative addresses.

30   Advantageous further developments are defined in the dependent claims.

BRIEF DESCRIPTION OF THE DRAWINGS

In the following, the present invention will be described in greater detail based on a preferred embodiment with reference to the accompanying drawings, in which:

Fig. 1 shows a schematic block diagram of a GPRS backbone network architec-
5   ture, in which the present invention can be implemented;

Fig. 2 shows a signaling diagram indicating indicating an Inter-SGSN routing area update procedure according to the preferred embodiment, and

Fig. 3 shows a signaling diagram indicating a Serving SRNS Relocation procedure according to the preferred embodiment.

10   DESCRIPTION OF THE PREFERRED EMBODIMENTS

The preferred embodiment will now be described based on a packet domain PLMN backbone network architecture as indicated in Fig. 1, in which an IPv6 to IPv4 address transition mechanism is used.

According to Fig. 1, a packet data network (PDN) 10 (e.g. an IP network) is con-
15   nected via a first GGSN 31 to a first PLMN 71 comprising a first Intra-PLMN back-
bone network 51. Furthermore, the first PLMN 71 includes at least a first SGSN 61 and a second SGSN 62 connected to each other and to the first GGSN 31 through the first Intra-PLMN backbone network 51. Additionally, the PDN 10 is connected to each other via a second GGSN 32 to a second PLMN 72 comprising a second
20   Intra-PLMN backbone network 52. Furthermore, the second PLMN 72 includes at least a third SGSN 63 connected to the second GGSN 32 through the second In-
tra-PLMN backbone network 52. The first and second PLMNs 71, 71 are con-
nected to each other via an Inter-PLMN backbone network 20. The connection between the first PLMN 71 and the Inter-PLMN backbone network 20 is provided
25   through a first border gateway (BG) 41. Similarly, the connection between the sec-
ond PLMN 72 and the Inter-PLMN backbone network 20 is provided through a second BG 42.

Each of the Intra-PLMN backbone networks 51, 52 may be a private IP network intended for packet domain data and signaling. A private IP network is an IP net-
30   work to which some access control mechanism is applied in order to achieve a

required level of security. The Inter-PLMN backbone network 20 can be packet data network, e.g. the public Internet or a leased line, which may be selected by a roaming agreement including a BG security functionality (i.e. typically just a router with security functions). The first and second BGs 41, 42 are not defined within the
5   scope of the packet domain.

The GPRS Support Nodes (GSNs), i.e. the first to third SGSNs 61 to 63 and the first and second GGSNs 31, 32, contain functionality required to support GPRS functionality for GSM (Global System for Mobile communication) and/or UMTS. In particular, the first and second GGSNs 31, 31 represent network nodes which are
10   accessed by the PDN 10 due to evaluation of the PDP address. It contains routing information for GPRSattached users. The routing information is used to tunnel packet data units (PDUs) to the MT's current point of attachment, i.e. the respec- tive Serving SGSN. Thus, the first and second GGSNs 31, 32 are the first point of PDN interconnection with the first and second PLMNs 71, 72, respectively. The
15   first to third SGSNs 61 to 63 represent nodes for serving the MT. Each SGSN supports GPRS for GSM and/or UMTS.

Further details regarding the network architecture and signaling procedures can be gathered from the 3GPP (3rd Generation Partnership Project) specification TS 23.060 Release 4.

20   According to the preferred embodiment, an SGSN willing to use an IPv6 address- ing will always indicate IPv6 and also IPv4 SGSN addresses in a respective GTP signaling message used to request creation of a GTP tunnel to the selected GGSN. Optionally, the SGSN may also indicate IPv6 and also IPv4 SGSN ad- dresses in a respective GTP signaling message used to request update of a GTP
25   tunnel. But this is not necessary if before sending the update, the SGSN already knows the type of addresses supported by GGSN. It may however be useful if the operator like to configure on a node by node basis the technology to be used (may be due to intermediate network).

30   If the selected GGSN supports IPv6 in the network plane, it shall also indicate IPv6 addresses in the corresponding GTP response message together with IPv4 ad- dresses. The IPv4 addresses are stored in the SGSN and not used for transmis- sion. IPv6 addresses are used for transmission on the network plane. In case of an inter SGSN handover, IPv4 and IPv6 addresses shall be given to the new
35   SGSN in a backward compatible way. If the new SGSN does not support IPv6 ad-

dresses, it uses the obtained IPv4 addresses to update the tunnel towards the GGSN. Also the GGSN may start receiving user data from the new SGSN before the tunnel has been updated. Therefore the first and second GGSNs 31, 32 shall be ready to receive GTP packets (signaling or user data) on either IPv4 or IPv6

5   addresses.

It should be noted, that in future a new SGSN may be provided, which is capable of using only IPv6 on network plane, and same principles would apply.

10   As an implementation alternative, the node could select the transmission technology (IPv4 or IPv6) to be used based on operator configuration

If the selected GGSN does not support IPv6 in the network plane, it indicates only IPv4 addresses in the corresponding GTP response message. IPv4 addresses are

15   then used for transmission on the network plane as currently defined.

Because it is proposed to send the IPv6 address as a new optional information element, backward compatibility can be provided so as to introduce IPv6 in future network nodes and maintain connections on the network plan even if a new SGSN

20   supports only IPv4.

In the following, examples for specific signaling messages and the incorporation of a specific address field for transmitting an alternative address will be described with reference to Figs. 2 and 3. Specific details regarding the signaling messages and procedures can be gathered from the 3GPP specifications TS 29.060 and TS

25   23.060 Release 4.

A Create PDP Context Request is sent from a SGSN node to a GGSN node as a part of the GPRS PDP Context Activation procedure. A valid request initiates the creation of a tunnel between a PDP Context in a SGSN and a PDP Context in a GGSN. If the SGSN prefers to use IPv6 below GTP, it include the IPv6 addresses

30   in new message fields Alternative SGSN Address, and an alternative or equivalent IPv4 address in existing message fields SGSN address. If the GGSN supports IPv6 below GTP, it stores and uses the alternative IPv6 SGSN addresses for communication with the SGSN. If the GGSN supports only IPv4 below GTP, it stores and uses the IPv4 SGSN addresses for communication with the SGSN. The

SGSN accepts packets whether they are sent to its IPv4 or IPv6 address. The GGSN should not store SGSN IP addresses that it does not use. This mechanism provides maximum flexibility, as it is not based on special DNS features, and allows the GGSN to have processes using IPv4 only and processes using both IPv4

5   and IPv6.

The following Table 1 shows the specific information elements provided in the Create PDP Context Request message.

Table 1:

Information element	Presence require-ment
IMSI	Conditional
Recovery	Optional
Selection mode	Conditional
Tunnel Endpoint Identifier Data	Mandatory
Tunnel Endpoint Identifier Control Plane	Conditional
NSAPI	Mandatory
Linked NSAPI	Conditional
Charging Characteristics	Optional
Trace Reference	Optional
Trace Type	Optional
End User Address	Conditional
Access Point Name	Conditional
Protocol Configuration Options	Conditional
SGSN Address for signalling	Mandatory
SGSN Address for user traffic	Mandatory
Alternative SGSN Address for signalling	Optional
Alternative SGSN Address for user traffic	Optional
MSISDN	Conditional
Quality of Service Profile	Mandatory
TFT	Conditional
Trigger Id	Optional
OMC Identity	Optional
Private Extension	Optional

The Create PDP Context Response message is sent from the GGSN node to the SGSN node as a response of a Create PDP Context Request. When the SGSN receives the Create PDP Context Response with the Cause value indicating 'Request Accepted', the SGSN activates the PDP context and may start to forward PDUs to/from the MT from/to the external data network.

- 10 -

If the GGSN supports IPv6 below GTP, and the SGSN included an IPv6 SGSN address in the request, the GGSN shall include the IPv6 addresses in the new fields Alternative GGSN Address, and an equivalent IPv4 address in the fields

5   GGSN address. The SGSN uses the alternative IPv6 GGSN addresses for com-munication with the GGSN, except if the operator has configured the use of IPv4. The SGSN stores the GGSN addresses and sends them to a new SGSN in a PDP context response message (message sent by old SGSN to new SGSN, after an MS has performed a Routing area update procedure to a new SGSN, that the new

10   SGSN has sent a PDP context request message to the old SGSN). The GGSN shall accept packets whether they are sent to its IPv4 or IPv6 address. This mechanism avoids losing connection if the new SGSN support IPv4 only below GTP.

15   Table 2 shows specific information elements provided in the Create PDP Context Response message.

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Table 2:

Information element	Presence requirement
Cause	Mandatory
Reordering required	Conditional
Recovery	Optional
Tunnel Endpoint Identifier Data	Conditional
Tunnel Endpoint Identifier Control Plane	Conditional
Charging ID	Conditional
End User Address	Conditional
Protocol Configuration Options	Optional
GGSN Address for Control Plane	Conditional
GGSN Address for user traffic	Conditional
Alternative GGSN Address for Control Plane	Conditional
Alternative GGSN Address for user traffic	Conditional
Quality of Service Profile	Conditional
Charging Gateway Address	Optional
Private Extension	Optional

Furthermore, an Update PDP Context Request message is sent from a SGSN to a
GGSN as part of the GPRS Inter SGSN Routing Update procedure or the PDP

5   Context Modification procedure or to redistribute contexts due to load sharing.
The SGSN may use SGSN IPv6 addresses only if it has received an IPv6 GGSN
address from an old SGSN (Inter SGSN Routing Area Update case) or GGSN
(PDP context modification). Otherwise SGSN uses SGSN IPv4 addresses.

10   If the GGSN supports IPv6 below GTP, and the SGSN included an IPv6 SGSN
address in the request, the GGSN includes the IPv6 addresses in the fields Alter-
native GGSN Address, and an equivalent IPv4 address in the fields GGSN ad-
dress. The SGSN uses the alternative IPv6 GGSN addresses for communication
with the GGSN. The SGSN may store both IPv4 and IPv6 GGSN addresses and

15   send them to a new SGSN in PDP context response message. The GGSN
alternative address fields are not sent if the GGSN address field is not sent. This

- 12 -

mechanism guarantees that the SGSN always stores proper IPv4 and IPv6 GGSN addresses, so that connection will not be lost if moving to a new SGSN supporting only IPv4 below GTP.

5   In the following Table 3, specific information elements in the Update PDP Context Response message are shown.

Table 3:

Information element	Presence require-ment
Cause	Mandatory
Recovery	Optional
Tunnel Endpoint Identifier Data	Conditional
Tunnel Endpoint Identifier Control Plane	Conditional
Charging ID	Conditional
GGSN Address for Control Plane	Conditional
GGSN Address for User Traffic	Conditional
Alternative GGSN Address for Control Plane	Conditional
Alternative GGSN Address for user traffic	Conditional
Quality of Service Profile	Conditional
Charging Gateway Address	Optional
Private Extension	Optional

10

Furthermore, as regards the SGSN Context Request message, the new SGSN sends this message to the old SGSN to get the mobility management (MM) and PDP Contexts for the MT. The old SGSN responds with an SGSN Context Re-

15   sponse.

The new SGSN adds an SGSN Address for the control plane. If the new SGSN supports IPv6 below GTP, it adds its IPv6 address in the field Alternative SGSN

Address for Control Plane. The old SGSN then selects the SGSN address for Control Plane depending on its IPv6 supports, and stores this selected SGSN Address and uses it when sending control plane messages for the MT to the new SGSN in the SGSN context transfer procedure.

5

Table 4 shows specific information elements provided in the SGSN Context Request message.

Table 4:

Information element	Presence requirement
IMSI	Conditional
Routing Area Identity (RAI)	Mandatory
Temporary Logical Link Identifier (TLLI)	Conditional
Packet TMSI (P-TMSI)	Conditional
P-TMSI Signature	Conditional
MS Validated	Optional
Tunnel Endpoint Identifier Control Plane	Mandatory
SGSN Address for Control Plane	Mandatory
Alternative SGSN Address for Control Plane	Conditional
Private Extension	Optional

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The old SGSN sends an SGSN Context Response message to the new SGSN as a response to a previous SGSN Context Request. The old SGSN may use SGSN IPv6 addresses only if it received IPv6 SGSN address from the new SGSN. Otherwise SGSN shall use SGSN IPv4 addresses.

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The new SGSN sends an SGSN Context Acknowledge message to the old SGSN as a response to the SGSN Context Response message. Only after receiving the SGSN Context Acknowledge message, the old SGSN starts to forward user data packets. SGSN Context Acknowledge indicates to the old SGSN that the new

SGSN has correctly received PDP Context information and is ready to receive user data packets.

The new SGSN uses an SGSN Address for user traffic, which may differ from that

5 provided by the underlying network service (e.g. IP). The old SGSN stores this SGSN Address and uses it when sending downlink PDUs to the new SGSN for the MT. The SGSN may use IPv6 addresses only if it received IPv6 SGSN address for control plane from the old SGSN. Otherwise the SGSN use SGSN IPv4 addresses.

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Fig. 2 shows a signaling diagram indicating an Inter-SGSN routing area update procedure according to the preferred embodiment.

In this signaling example, the MT sends a Routing Area Update Request to a new

15 SGSN, so as to initiate a routing area update. In response thereto, the new SGSN sends an SGSN Context Request message including the SGSN Address fields and the Alternative SGSN Address fields to the old SGSN. In response thereto, the old SGSN returns an SGSN Context Response message in which the desired address type is set in the SGSN Address for Control Plane fields, and all GGSN

20 IPv4 and IPv6 addresses are included if available. The new SGSN responds with an SGSN Context Acknowledge message including the used address type information. Then, the new SGSN sends an Update PDP Context Request message including the set address type information to the respective GGSN. This message is sent using a GGSN IP address received from old SGSN. If the new SGSN and

25 GGSN support IPv6 on the network plane, the IPv6 address of GGSN is preferably used. If either SGSN or GGSN does not support IPv6, IPv4 addresses are used. Here, it is assumed that in a first phase of transition towards IPv6, all nodes support IPv4. The GGSN returns an Update PDP Context Response message including the GGSN Address fields and the Alternative GGSN Address fields. These ad-

30 dress fields are especially necessary in the following cases:

- The old SGSN supported only IPv4, and had not stored the alternative GGSN address, so that the new SGSN needs to receive it from GGSN to be able to use IPv6 for the connection

5   - The GGSN has changed its IP address (typically due to a reallocation of the PDP context to a new processing card)

In addition, if for some reason, the GGSN is configured to use IPv4 to communicate towards the new SGSN (due to possible problem in intermediate IP network), 10   the GGSN will return only the IPv4 addresses and will not send an alternative address field containing the IPv6 address.

Finally, the required routing area update procedure is performed.

15   As a further GTP signalling message, a Forward Relocation Request message is defined, which is sent by an old SGSN to a new SGSN to convey necessary information to perform an SRNS (Serving Radio Network Subsystem) relocation procedure between the new SGSN and a target RNC (Radio Network Controller) of the UTRAN. In this case, the old SGSN adds an SGSN Address for Control 20   Plane field information. If the old SGSN supports IPv6 below GTP, it adds its IPv6 address in this field Alternative SGSN Address for Control Plane. The new SGSN selects the SGSN address for Control Plane depending on its IPv6 supports, and stores this selected SGSN address and uses it when sending control plane messages for the MT to the old SGSN in the SRNS relocation procedure.

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Table 5 shows specific information elements provided in the Forward Relocation Request message.

- 16 -

Table 5:

Information element	Presence requirement
IMSI	Mandatory
Tunnel Endpoint Identifier Control Plane	Mandatory
RANAP Cause	Mandatory
MM Context	Mandatory
PDP Context	Conditional
SGSN Address for Control plane	Mandatory
Alternative SGSN Address for Control plane	Optional
Target Identification	Mandatory
UTRAN transparent container	Mandatory
Private Extension	Optional

The new SGSN sends a Forward Relocation Response message to the old SGSN
5   as a response to a previous Forward Relocation Request message. The new
SGSN adds an SGSN Address for Control Plane information. The SGSN may
insert IPv6 addresses only if it received an IPv6 SGSN address for control plane
from the old SGSN. Otherwise the new SGSN uses SGSN IPv4 addresses. The
old SGSN stores this SGSN address and uses it when sending control plane mes-
10   sages for the MT to the new SGSN in the SRNS relocation procedure.
Fig. 3 shows a signaling diagram indicating an SRNS (Serving Radio Network
Subsystem) relocation procedure according to the preferred embodiment.

In this signaling example, a source SRNS of the UTRAN decides to perform or
15   initiate an SRNS relocation and sends a Relocation Required message to the old
SGSN. In response thereto, the old SGSN determines if the SRNS relocation is an
inter-SGSN SRNS relocation and, if so, it sends a Forward Relocation Request
message including the SGSN Address field and the Alternative SGSN Address
field for control plane signaling to the respective new SGSN. In response thereto,
20   the new SGSN send a Relocation Request message to the target Radio Network
Controller (RNC) of the UTRAN. Then, the Iu bearers of the radio access bearers

- 17 -

(RABs) are setup between the target RNC and the new SGSN as the existing radio bearers will be reallocated between the MT and the target RNC when the target RNC takes the role of the Serving RNC in the new SRNS. After the new SGSN has received the Relocation Request Acknowledgement message from the

5   UTRAN, the GTP tunnels are established between the target RNC and the new SGSN. Then, the Forward Relocation Response message is sent from the new SGSN to the old SGSN to thereby indicate that the target RNC is ready to receive from the source SRNC (Serving RNC) of the SRNS the forwarded packet data units (PDUs). The old SGSN continues the SRNS relocation by sending a Reloca-

10 tion Command message to the source SRNC. The source SRNC is now ready to forward downlink user data directly to the target RNC. When the data forwarding is completed, the target RNC send a relocation Detect message to the new SGSN. In response thereto, the new SGSN sends an Update PDP Context Request message to a concerned GGSN. The GGSN returns an Update PDP Context Re-

15 sponse message including the GGSN Address fields and the Alternative GGSN Address fields. When the new SGSN receives a Relocation Complete message from the SRNC, a Forward Relocation Complete signaling is exchanged between the new and the old SGSNs , and then the old SGSN initiates an Iu release procedure at the SRNC. Finally, if the new Routing Area Identification is different, the

20 MT initiates a Routing Area Update procedure.

Furthermore, a PDP Context information element contains the Session Management parameters, defined for an external packet data network address, that are necessary to transfer between SGSNs at the Inter SGSN Routing Area Update

25 procedure.

If the GGSN negotiated the use of IPv6 below GTP with the old SGSN, the old SGSN sets Alternative GGSN Address for User Traffic and Alternative GGSN Address for Control Plane fields to contain the IPv6 addresses to be used to commu-

30 nicate with the GGSN. A new SGSN not supporting IPv6 below GTP ignores these alternative GGSN addresses, and uses for communication the GGSN Address for User Traffic and GGSN Address for Control Plane fields. A new SGSN supporting IPv6 below GTP stores the GGSN Address for User Traffic and GGSN Address for

Control Plane, but uses use for communication the Alternative GGSN Address for
User Traffic and Alternative GGSN Address for Control Plane.

In Table 6, a PDP Context information field is shown.

5

Table 6

Byte					
1	Type = 130 (Decimal)				
2-3	Length				
4	Reserved	VAA	Reserved	Order	NSAPI
5	X	X	X	X	SAPI
6	QoS Sub Length				
7 - (q+6)	QoS Sub [4..255]				
Q+7	QoS Req Length				
(q+8)-(2q+7)	QoS Req [4..255]				
2q+8	QoS Neg. Length				
(2q+9)-(3q+8)	QoS Neg [4..255]				
(3q+9)-(3q+10)	Sequence Number Down (SND)[1]				
(3q+11)-(3q+12)	Sequence Number Up (SNU)[1]				
3q+13	Send N-PDU Number[1]				
3q+14	Receive N-PDU Number[1]				
(3q+15)-(3q+18)	Uplink Tunnel Endpoint Identifier Control Plane				
(3q+19)-(3q+22)	UplinkTunnel Endpoint Identifier Data I				
3q+23	PDP Context Identifier				
3q+24	Spare 1 1 1 1			PDP Type Organisation	
3q+25	PDP Type Number				
3q+26	PDP Address Length				
(3q+27)-m	PDP Address [1..63]				
M+1	GGSN Address for control plane Length				
(m+2)-n	GGSN Address for control plane [4..16]				
N+1	GGSN Address for User Traffic Length				
(n+2)-o	GGSN Address for User Traffic [4..16]				
O+1	APN length				
(o+2)-p	APN				
P+1	Spare (sent as 0 0 0 0)			Transaction Identifier	
P+2	Transaction Identifier				
	Alternative GGSN Address for control plane Length				
	Alternative GGSN Address for control plane [4..16]				
	Alternative GGSN Address for User Traffic Length				
	Alternative GGSN Address for User Traffic [4..16]				

If having either IPv6 or IPv4 address in GGSN Address for Control Plane is al-
lowed, GGSN Address for Control Plane of the PDP context information field may
sometimes be an IPv6 address and sometimes an IPv4 address during an active
5   PDP context. This may happen e.g. if GGSN indicates IPv6 address in GGSN Ad-
dress for Control Plane and IPv4 address in Alternative GGSN Address for Control
Plane at PDP context activation, whereas an old SGSN indicates IPv4 address in
GGSN Address for Control Plane to a new SGSN at routing area update. In this
case, GGSN Address for Control Plane is the same in GGSN and old SGSN,
10   whereas GGSN Address for Control Plane is different in new SGSN. In this case,
e.g. charging correlation by using GGSN Address for Control Plane does not work.

According to the preferred embodiment, a GGSN supporting both IPv6 and IPv4
adds both IPv6 address and IPv4 address to CDRs (Call Detailed Records) cre-
ated for a PDP context, i.e. to G-CDRs. The SGSN may add either one IP ad-
15   dress, i.e. GGSN Address for Control Plane, or two IP addresses, i.e. GGSN Ad-
dress for Control Plane and Alternative GGSN Address for Control Plane, to the
CDRs created for the PDP context, i.e. to S-CDRs. This way, it is possible for the
CGF (Charging Gateway Functionality) to correlate CDRs created by the GGSN
(including both IPv6 address and IPv4 address) and CDRs created by the
20   SGSN(s) (including either one IP address, IPv6 or IPv4, or including both IPv6 ad-
dress and IPv4 address).

In addition to charging, correlation may be needed e.g. for lawful interception or
CAMEL messages or information. In general, any message or information gener-
ated by multiple nodes can be correlated based on the address and alternative
25   address information. For lawful interception correlation, GGSN sends both IPv6
address and IPv4 address, whereas SGSN may send either one IP address, i.e.
GGSN Address for Control Plane, or two IP addresses, i.e. GGSN Address for
Control Plane and Alternative GGSN Address for Control Plane. GGSN thus sends
both IPv6 address and IPv4 address, whereas SGSN may send either IPv6 ad-
30   dress or IPv4 address or both for lawful interception correlation. This way, it is
possible to correlate e.g. lawful interception information created by GGSN for the
PDP context and lawful interception information created by SGSN(s) for the PDP
context.

It is noted that the present invention can be implemented in any cellular network to
35   provide address backward compatibility or message correlation function, when an

address information is transferred between network nodes. The names of the various functional entities, signaling messages and information elements used in the context of the preferred embodiment are not intended to limit or restrict the inven-. tion. The preferred embodiments may thus vary within the scope of the attached

5   claims.

- 22 -

Claims

1. A method for providing an address or network transition if a connection point at one end of a connection is changed from a first network node to a second network node of a cellular network, said method comprising the steps of:

    a) transmitting an address information and at least one alternative address information in a signaling message from said first network node to said second network node;

    b) selecting one of said address information and said alternative address information at said second network node; and

    c) using said selected address information for re-establishing said connection towards a third node at the other end of said connection.

2. A method according to claim 1, wherein, when establishing said connection, possible addresses to be used for this connection are transmitted as said address information and said at least one alternative address information in a signaling message from said first network node to said third network node, and addresses of said third node are stored in said first network node.

3. A method according to claim 1 or 2, where said address information can be used to address a node according to an old addressing or network, used before the transition, and said alternative address information can be used to address a node according to the new addressing or network.

4. A method according to any one of the preceding claims, wherein said signaling message is sent as part of a location or routing area update message or a relocation procedure.

5. A method according to any one of the preceding claims, wherein said signaling message is a GTP message.

6. A method according to any one of the preceding claims, wherein said first and second network nodes are SGSNs, and said third network node is a GGSN.

- 23 -

7. A method according to any one of the preceding claims, wherein said ad-
dress information and said alternative address information are a user and/or
network addresses.

8. A method according to claim 7, wherein said address information and said
5   alternative address information are IPv4 or IPv6 addresses.

9. A method according to any one of the preceding claims, wherein said ad-
dress information and said alternative address information are transmitted
in respective predetermined fields of said signaling message.

10. A method according to claim 9, wherein said predetermined fields are pro-
10   vided in a PDP context information field.

11. A method according to any one of the preceding claims, wherein said alter-
native address information is coded as an optional information so that a
network node not supporting said alternative address information ignores it.

12. A method according to claim 11, wherein said connection is re-established
15   with an old addressing mechanism based on said address information if
said second node ignores said alternative address information.

13. A method for providing a message correlation function in a data network,
said method comprising the steps of:
a) adding an address information and at least one alternative address in-
20   formation to a message at a first network node;
b) selecting one of said address information and said alternative address
information at a second network node to which said message has been
routed; and
c) using said selected address information for correlating said message to
25   a message received from a third network node.

14. A method according to claim 13, wherein said message is a call record for
charging purposes.

15. A method according to claim 13 or 14, wherein said second network node is
a charging gateway functionality.

16. A method according to claim 13, wherein said message is a lawful intercep-
tion information or an information of a customized application.

17. A system providing an address or network transition, said system compris-
ing:
   a) a first network node for transmitting an address information and at least
   one alternative address information in a signaling message if a connec-
   tion point at one end of a connection is changed from said first network
   node; and
   b) a second network node for receiving said signaling message if said con-
   nection point is changed to said second network node, for selecting one
   of said address information and said alternative address information,
   and for using said selected address information for re-establishing said
   connection towards a third network node at the other end of said con-
   nection.

18. A system according to claim 17, wherein said first and second network
nodes are SGSNs of a GPRS backbone network, and wherein said third
network node is a GGSN of said GPRS backbone network.

19. A system for providing a message correlation function in a data network,
said system comprising:
   a) a first network node for adding an address information and at least one
   alternative address information to a message;
   b) a second network node for receiving said selecting one of said address
   information and said alternative address information to which said
   message has been routed; and
   c) using said selected address information for correlating said message to
   a message received from a third network node.

20. A system according to claim 19, wherein said message is a call record for
charging purposes.

21. A system according to claim 19 or 20, wherein said second network node
has a charging gateway functionality.

22. A system according to claim 19, wherein said message is a lawful intercep-
tion information or an information of a customized application.

23.   A network node of a cellular network, said network node being arranged to transmit an address information and at least one alternative address information in a signaling message, if a connection point at one end of a connection is changed from said network node to another network node.

24.   A network node according to claim 23, where said transmitted address information and said at least one alternative address information is used to reestablish said connection towards a third node.

25.   A network node according to claim 24, wherein said network node is adapted to store said address information and said alternative address information in order to be used to address said third network node.

26.   A network node according to any one of claims 23 to 25, wherein said network node is an SGSN.

27.   A network node of a cellular network, said network node being arranged to receive a message if a connection point at one end of a connection is changed from another network node to said network node, to select one of an address information and an alternative address information provided in said message, and to use said selected address information for reestablishing said connection towards a third network node at the other end of said connection.

28.   A network node according to claim 27, wherein said network node is adapted to receive data and/or signaling either on said address information or on said alternative address information.

29.   A network node according to claim 27 or 28, wherein said network node is a GGSN.

30.   A network node of a cellular network, said network node being arranged to receive a message if a connection point at one end of a connection is changed from another network node to said network node, to select one of an address information and an alternative address information provided in said message, and to use said selected address information for correlating said message to a message received from a third network node.
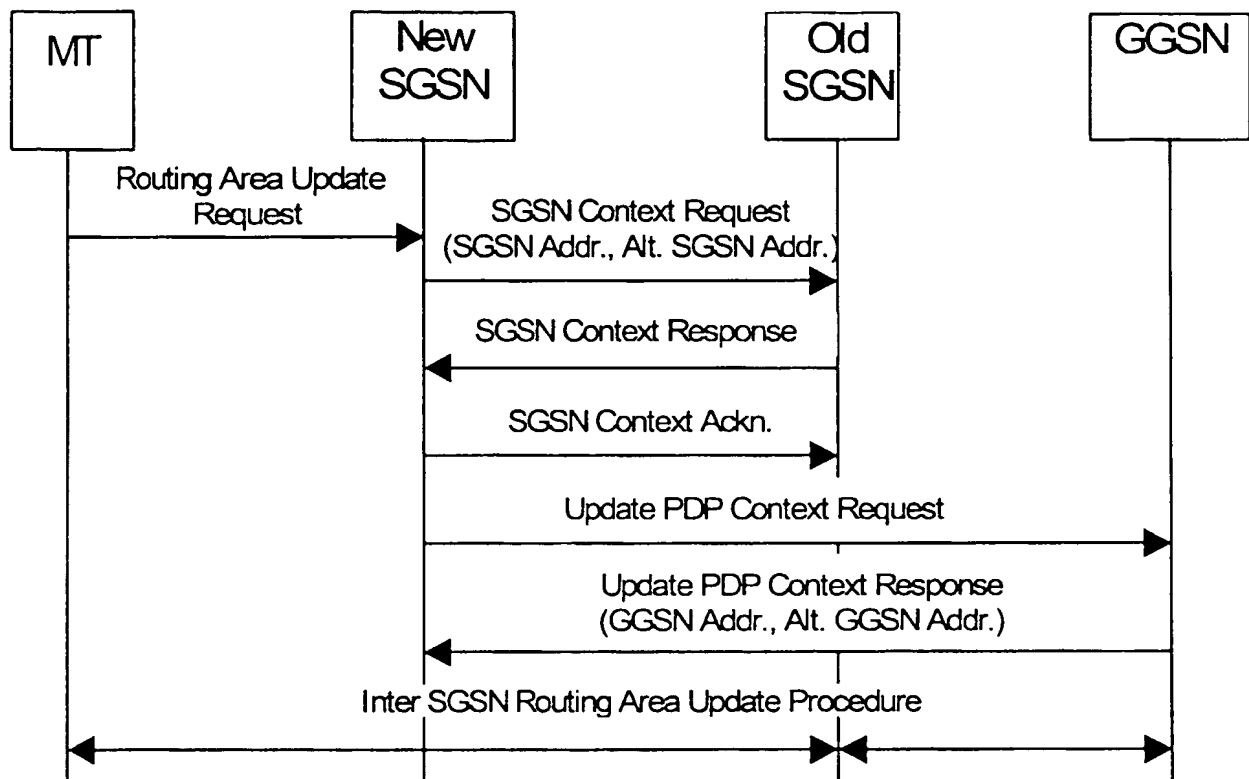
- 26 -

31. A network node according to claim 30, wherein said network node has a charging gateway functionality, and said signaling message is a charge record.

32. A network node according to claim 30, wherein said message is a lawful interception information or an information of a customized application.
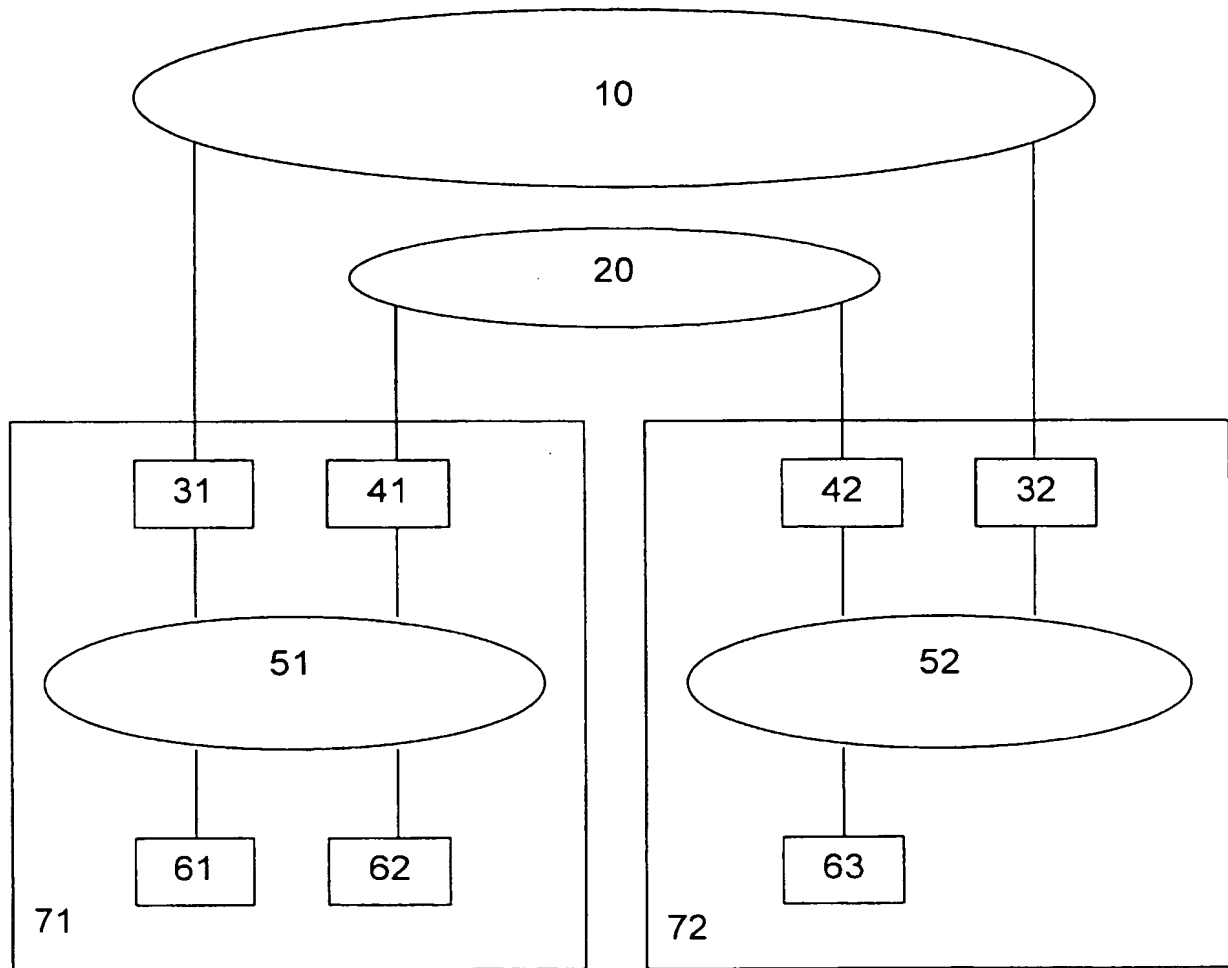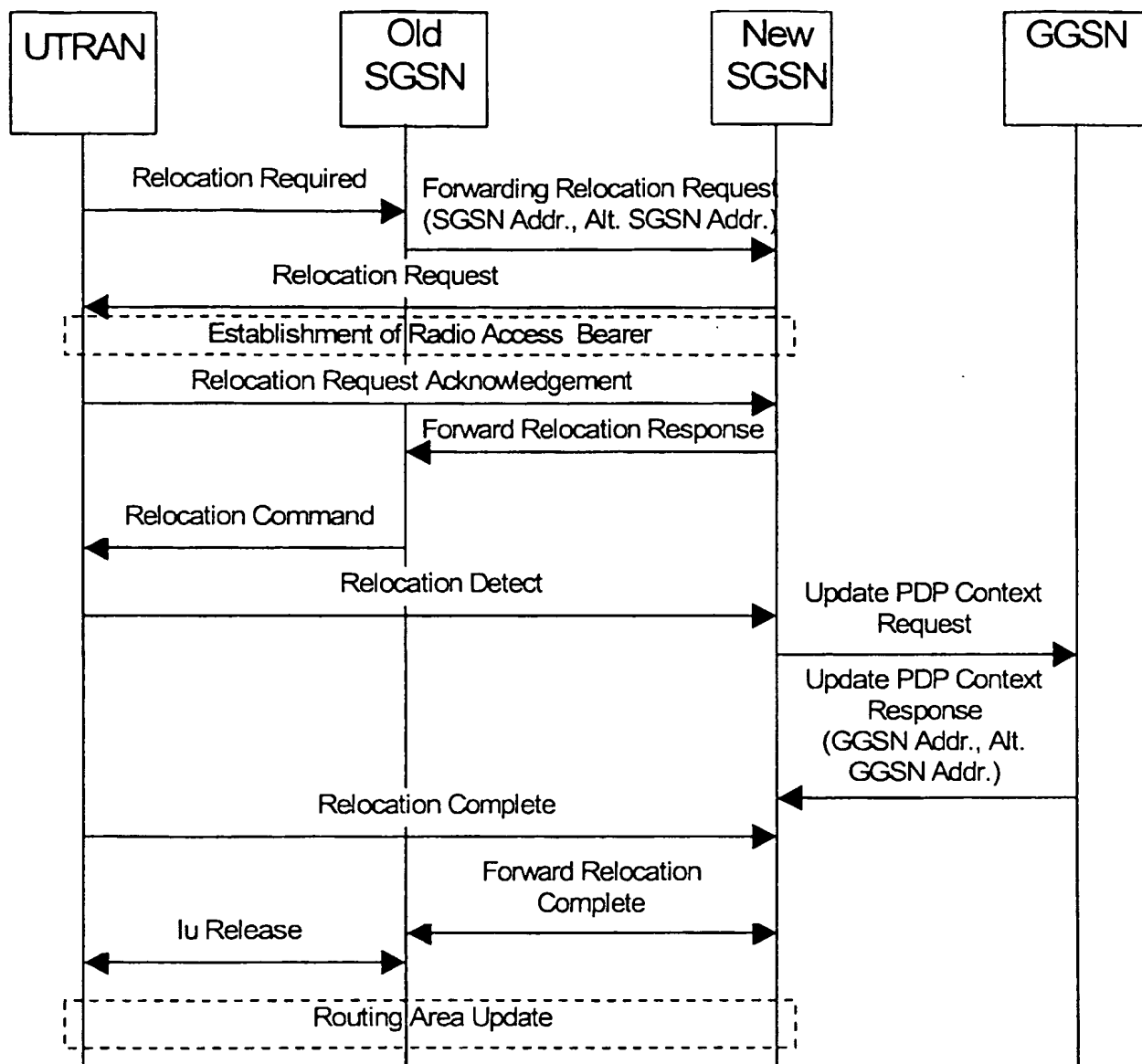
Fig. 1

Fig. 2

Fig. 3

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7   H04L29/06   H04L12/56

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7   H04L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category°	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	WO 00 22839 A (NOKIA NETWORKS) 20 April 2000 (2000-04-20) page 3, line 14 - line 22 page 7, line 16 - line 19 page 9, line 3 - line 13 page 11, line 1 - line 5 figure 2 abstract ---	1-32
Y	US 6 172 986 B1 (OURA TETSUO ET AL) 9 January 2001 (2001-01-09) abstract column 3, line 35 - line 63 column 6, line 25 - line 47 --- -/--	1-32

[X] Further documents are listed in the continuation of box C.   [X] Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

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"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
5 March 2003	13/03/2003

Name and mailing address of the ISA	Authorized officer
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3

Form PCT/ISA/210 (second sheet) (July 1992)

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT		
Category *	Citation of document, with indication,where appropriate, of the relevant passages	Relevant to claim No.
A	EP 1 093 312 A (AGILENT TECHNOLOGIES INC) 18 April 2001 (2001-04-18) paragraph '0016! - paragraph '0017!	13-16, 19-22, 30-32

3

Form PCT/ISA/210 (continuation of second sheet) (July 1992)

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EP 1093312	A	18-04-2001	EP	1093312 A2	18-04-2001